



# Steel makes the world go round

Whether bikes, bulldozers or ball bearings: Hardly anything moves without steel helping to run things smoothly – whether large-scale parts or tiny components. And even when steel itself is being transported, you can be pretty sure that steel equipment and components always play a key role in getting it where it needs to go. On the trail of the material that keeps our world going round



# Behind the wheel

A visit to Salzgitter customer Maxion Wheels in Königswinter brought two surprising discoveries: It is possible to reinvent the wheel, which is, by the way, not the same thing as a rim

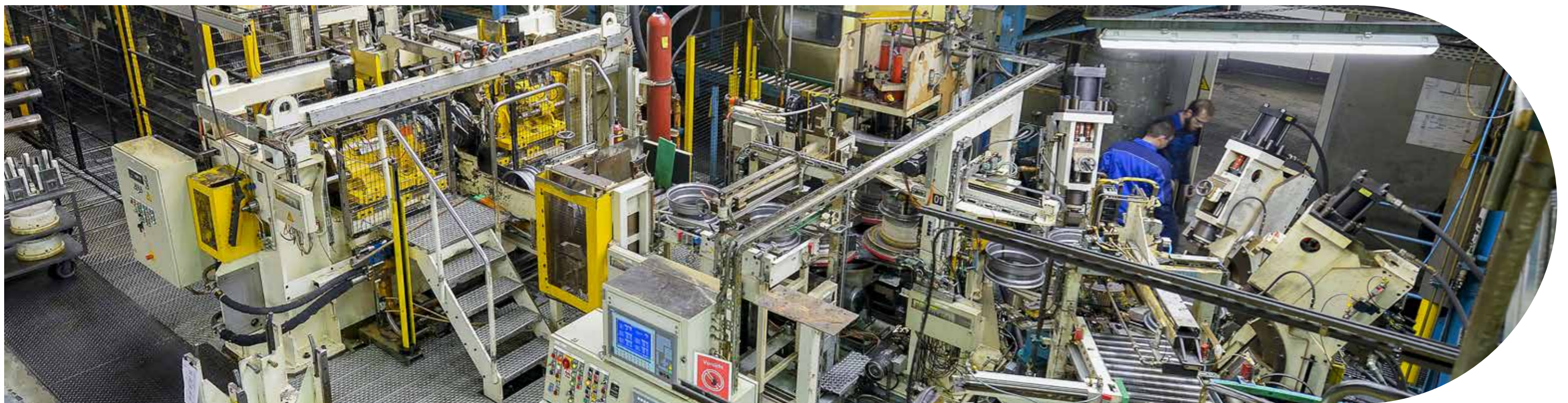




Photo: XXXXXX



Unloading a coil (top left) and lifting it directly into one of the two coil warehouses by crane. The narrower plate used to press the rims is loaded onto the reel in the cut-to-length line (left), while the wider plate is pressed into blanks for wheel disc production by the cutting press (right). All production processes are highly automated and are both controlled and monitored by computers (below)



Photos: Gunnar Garms

You can't reinvent the wheel, as the saying goes. At least that's what our group of visitors from Salzgitter thought as we set out on a tour through the production halls of Maxion Wheels Werke GmbH in Königswinter – but it wasn't long before we had changed our minds. The production process here is complex and sophisticated. Salzgitter AG plate is cut, cold formed, welded and painted before it can be ultimately screwed onto your car as a finished wheel. As we found out talking to the experts, there is indeed plenty of room for innovation in wheel-making – particularly when it comes to aspects like weight reduction, aerodynamics and design.

Königswinter, located to the south east of Bonn, is a town spreading out over 76 km<sup>2</sup> of surface area and 41,000 inhabitants. The Maxion Wheels production sites are located in the town's Niederdollendorf district, nestling in beside the mighty Rhine. In this part of town, a railway forms the one-way main street and the fastest connection to the other bank of the river is a ferry. The former guest house of the Federal Republic of Germany, the Petersberg, sits atop a nearby peak of the Siebengebirge range of hills, while Schloss Drachenburg and the Drachenfels castle ruin also overlook this scenic valley.

And it was in these idyllic surroundings that Johann, Franz and Simon Lemmerz founded a car wheel factory in 1919. At this point in time, when most automobiles were still trundling the streets on wood spoke wheels, the enterprising brothers did indeed succeed in reinventing the wheel: They developed the multi-piece wheel, which remains popular to this day. Their new steel disc wheels helped the Opel 4 PS, lovingly known

as the "Laubfrosch" or "tree frog" for its quirky green paint job, become the first German car for the "average man". It was in no small part thanks to the new wheels that the Opel was so well suited to mass production: As the first German assembly line passenger vehicle – an unabashed copy of the Citroën 5CV by the way – almost 120,000 of these cars were produced between 1924 and 1931, a success which helped the Lemmerzwerk become the third largest German wheel-maker of the era. In 1997, "Lemmerz-Werk GmbH" renamed itself "Hayes Lemmerz International Inc.". Since the takeover by the Brazilian holding company Iochpe Maxion in 2012, the new company name "Maxion Wheels" has been boldly emblazoned on the production halls here. With an annual production volume in excess of 58 million wheels (2017), the company is currently the world's largest producer of wheels for passenger vehicles, heavy goods vehicles, buses, fork-lifts, agricultural and off-road vehicles.

### Why a rim is not a rim

It's not long before we learned another lesson: Our Maxion expert clarifies the important distinction between "rims" and "wheels", two terms commonly (and incorrectly) used interchangeably. In technical terms, only the outer ring of the wheel which holds the tire should be referred to as the "rim". The inner section, which later connects the wheel to the axle hub, is called the wheel disc. In the case of steel wheels, the rim and disc are initially produced separately before being welded together. Aluminum wheels, in contrast, are almost always cast or forged in one piece.



Photos: Gunnar Garms

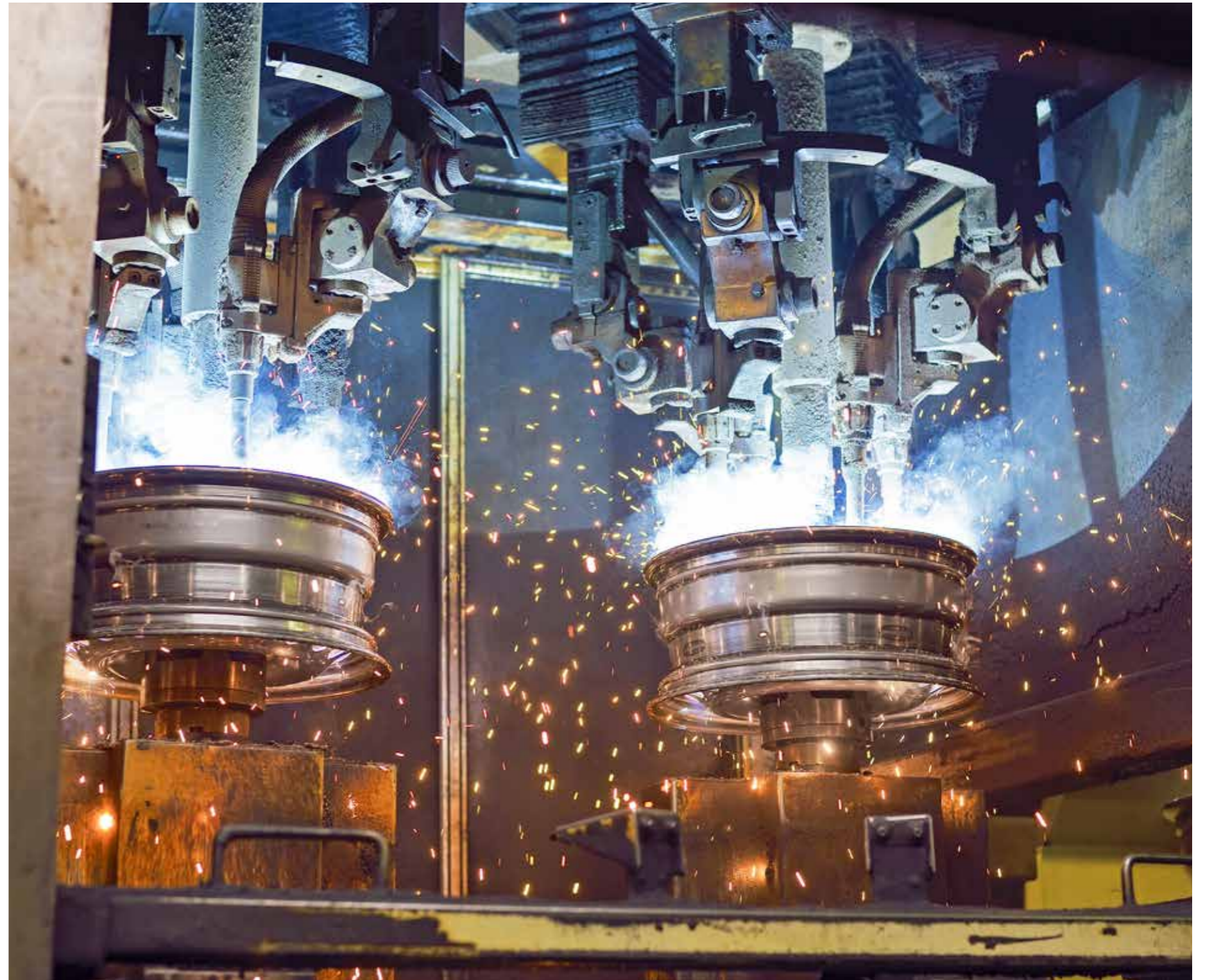
An employee inspects a finished commercial vehicle wheel disc in the disc line. Meanwhile, a colleague checks the welding seam of the rim. Both parts are “married” together in the wheel line, welded into a wheel in a matter of seconds.

Steel wheels are cold formed from hot rolled steel with a higher yield strength (> 600 MPa). Salzgitter Flachstahl is one of the suppliers to the Königswinter site. “To produce wheels for commercial vehicles, we also use steel from the former in-house hot strip mill Warmwalzwerk Königswinter,” as Ralf Sieberling, Head of Production and Manufacturing Engineering/Maintenance in Königswinter explains. However, the slabs for this process are partially sourced from “Hüttenwerke Krupp Mannesmann GmbH” (HKM) in which Salzgitter holds a 30% stake – and delivered by Salzgitter Mannesmann Stahlhandel as well.

The coils from Salzgitter arrive by rail and truck,

with a permanently installed crane doing the subsequent heavy lifting into one of the site’s two coil warehouses. At the start of the “disc line”, the coils are loaded onto a reel and straightener, decoiled and split into blanks, section by section, in the cut-to-length line. Any waste is then processed with the scrap shears and enters the recycling process.

The round cut steel blanks then go through various forming stages in the multi-stage press before they become finished wheel discs. By this point in the process, the typical ventilation holes are also visible in the wheel construction. When the wheels hit the road, these holes serve to dissipate any heat created under braking. As the discs are



being pressed, each workpiece is flushed with a mix of 90% water and 10% oil in order to cool and lubricate the tools.

To produce the rims, a section of material is formed into a cylindrical drum and welded at the cut edges. After that, machines press the profile – the “grooves” to laypeople – into the steel drum, allowing the disc to be welded on and the tires to grip the wheel when they are ready to roll.

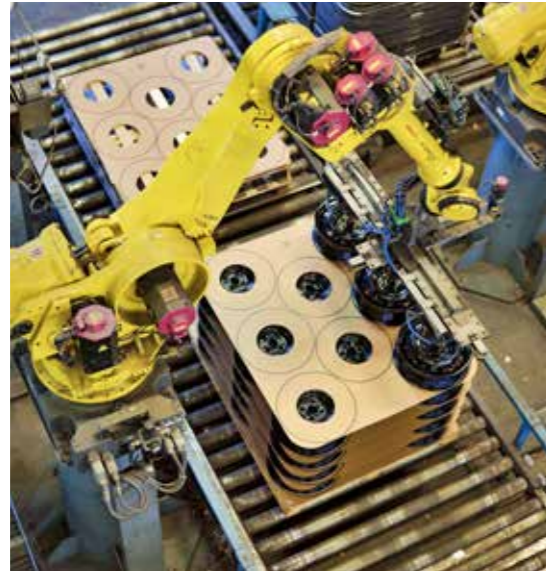
### Fully automatic welding

In the next step, the disc and rim are welded together. This might be the most exciting moment in

the entire production process. A robot lifts the disc into the rim, and a few minutes further down the line, a mechanism lifts both parts up to the welding heads – where blue and white sparks are spent spraying through the air. The welding process itself barely takes three seconds before the disc and rim are inseparably connected – a marriage that often lasts for many hundreds of thousands of kilometers. The disc and rim of wheels for commercial vehicles are welded all the way around, while eight welded sections are more than enough for lighter passenger car wheels.

The penultimate phase of the production process takes place in the paint shop. The primer is fired

The finished wheels are then packaged: One robot plucks up to three wheels from the conveyor belt at a time and packs them onto pallets, while another places plastic or cardboard spacers between the layers



at 200 °C and this is designed to protect the wheel against corrosion. A black or silver coating is then applied on top of this base layer. Depending on the respective customer and order, the entire wheel is painted or just the rim bed is left blank. This does not change anything in terms of the quality of the wheel, its function or its safety, and is merely a purely aesthetic difference.

The packaging process is left up to the robots. Two are required to stack each pallet. This entire process is only monitored by one sole employee. Overall, there are more than 100 robots working on site, and all production processes are aided, controlled and monitored by computers.

The pallets are stacked meters high here, in both the warehouses and outside areas. A quick glance at the delivery slips reveals the clients: renowned vehicle manufacturers with national and inter-

national production sites. More than 90% of the wheels are shipped by truck despite the proximity to the Rhine and rail connection. There's not a single aluminum wheel in sight here – the Königswinter site exclusively focuses on producing steel wheels.

At present, up to 60% of all passenger vehicles worldwide are running on aluminum wheels – largely due to aesthetic reasons and their weight advantage. However, there are signs that the passenger vehicle market could increasingly turn back to steel wheels as the industry evolves: Electric cars, for instance, will require new wheel models that do not currently exist. Perhaps wheels will be completely covered by bodywork in future with a view to improving aerodynamics. It would therefore make no difference aesthetically if tires were mounted to steel or aluminum wheels in future, as they would be hidden. Similarly, outward appearance is a lesser concern for the growing user base of carsharing services. The same applies for the Millennials generation which prioritizes different aspects of mobility over aesthetic design.

Could it then be time to reinvent the wheel all over again, just as the Lemmerz Brothers did all those years ago? Nowadays, this is a much more difficult task than it was almost a century ago. National guidelines and technical standards only allow limited room for maneuver. Both the Association of European Wheel Manufacturers (EUWA) and the European Tyre and Rim Technical Organisation (ETRTO) set obligatory specifications which every wheel producer must adhere to. On top of that, there are also customer requirements and legal standards to conform to.

However, this need not slow the innovation of a company like Maxion, particularly if its steel

producer Salzgitter AG can offer new options upstream. New high-strength steels allow thinner wall thicknesses in wheel production and corresponding weight reductions. “We are working closely together on these points,” explains Michael Bunte, Director Global CV Steel Product Development/Product Engineering at Maxion Wheels. “And to great success – as some of the latest steel wheels are already lighter than aluminum models!”

Innovative steels and new production processes such as “flow forming” have paved the way for this evolution. This process makes reductions in material thickness possible in areas where the wheel is subject to less stress. “By combining FEM simulation with our experience, we know where and how we can apply the flow forming process,” explains Michael Bunte. Wheels then ultimately weigh less without sacrificing anything in terms of quality or safety. Weight savings of 200 g are possible for a 15 inch wheel, roughly 500 g for a 16 and 17 inch wheel, and up to 3 kg for a truck wheel.

### Teamwork is important for both sides

From February, Maxion Wheels is set to build two new flow forming facilities in Königswinter. Making a switch to new production processes can be problematic. Existing presses are sometimes simply unable to provide the power required to form higher-quality steels. Other alloy additives could also cause problems. “Different types of material could suddenly become brittle from welding,” says Michael Bunte. “The trick is adjusting the processes to new challenges and aligning them together.”

Maxion Wheels and Salzgitter Flachstahl are working hand in hand to do just that. “Having great staff is half the battle, and they are our



capital,” says Pia Schütz, Purchasing Director at Maxion. “But the other people along the supply chain are just as important, and that includes suppliers like Salzgitter. In a sense, they are part of our extended team.”

This extended workforce therefore includes Ive Kopp from Salzgitter Flachstahl GmbH. She has headed a team responsible for selling to automotive customers since 2015. Ive Kopp entered the steel sales business after her dual degree (2004–2007) encompassing an apprenticeship as an industrial clerk and a bachelor's degree in business administration. Since 2017, she has been working on the relationship with Maxion Wheels and can only echo Pia Schütz's words: “We are in constant contact with a view to mastering any possible challenges together.” This lays the groundwork for ensuring that our roads are populated with as many Maxion wheels made with Salzgitter steel as possible in future.

**Maxion Wheels meets Salzgitter (from the left):** Juan José Canteli (Director Steel Operations Europe), Ive Kopp (SZFG), Colleen Hanley (Global Director, Marketing and Communications), Pia Schütz (Purchasing Director) and Michael Bunte (Director Global CV Steel Product Development/Product Engineering)



A final check in the paint shop: A team member examines the silver or black wheels under neon light

Photos: Gunnar Gairns



**History:** The world's largest wheel manufacturer for more than 100 years. It all began in 1908 with the foundation of Hayes Wheels in the USA (production of wood spoke wheels for the Ford model T).

**Production\*:** More than 58 million wheels

**Sales\*:** 1.9 billion US dollars

**Production sites:** 22 – in 16 countries across 5 continents

**Königswinter site:** Global Engineering Center Steel & Global Advanced Engineering Center. Production of steel passenger and commercial vehicle wheels (\*both 2017)

[www.maxionwheels.com](http://www.maxionwheels.com)



A view of Königswinter from Drachenfels. The Maxion works is visible in the top right

Photo: www.peddie.com